

An
Inaugural Dissertation
on the
Proper means for resuscitating the apparently dead
from drowning.

Submitted to the examination
of the

Trustees and Medical Professors
in the

University of Pennsylvania.

1813

Chemical Exposition

on the

Paper means for communicating the opportunity and
from drawing

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Gentlemen,

With much diffidence I submit the following dissertation to your inspection. The subject it comprises is unquestionably an important one; and I have to regret, that both time and talents have been wanting to do it justice —

Of very many imperfections in the succeeding pages, I am fully conscious, nor can I doubt that there are many more which will not escape your superior discernment. Yet I feel some confidence in believing, what I have said will be regarded with that lenity and candour, which ever distinguishes the noble heart and enlighten'd mind. My highest expectations will be answered, if by your decision I am enabled to say

Ut tunc demigra culparum

Nunc laudandi moris.

In treating the subject of this dissertation I have previously to laying down the proper means for resuscitating the apparently dead from drowning, described the common effects of drowning; these briefly enquire how the water acts in producing these effects, and afterwards, to throw some light on the indications of cure, takes a slight view of the nervous influence exerted on the lungs in respiration — My description of the common effects of drowning, is taken from Coleman; it agrees pretty generally with that given by all the writers on the subject, whose works I have had an opportunity of consulting. —

Common effects of drowning.

As soon as an animal is immersed in water, air is expelled from its lungs and immediate attempts are made apparently with great difficulty, to inspire, in which a small quantity of water is taken in. The animal betrays increasing uneasiness, again expels air and takes in water. The duration of this process

* See his inaugural dissertation.

ceases from one minute to four, where the muscles of respiration cease to act and all struggling is at an end. Some involuntary motions, however, generally succeed. On opening the chest, we find the two vena cavae, right sinus venosus, auricle, ventricle and pulmonary artery loaded with blood; the left auricle nearly distended with blood, the left ventricle about half the aorta and its branches containing a quantity of blood, which in all its appearances resembles venous. The lungs are found in a state of collapse, containing a small quantity of water, in the form of froth, but very trifling when compared to the quantity of air expelled from the lungs during the act of drowning. The stomach, on examination presents also a little water, which probably passed into the oesophagus when the rima glottidis was closed by the epiglottis; for as the water contained in the mouth is then refused admittance into the trachea, it should seem, that at that moment, it makes its way into the stomach; so that, as soon as the animal attempts to respire, water enters the trachea; but this organ, as if conscious of not receiving its due element, rejects the water, which is then allowed to pass into the oesophagus. Air is again emitted, and new efforts made to inspire, when upon the same sensation being produced, similar effects arise; and after the last expiration, no more water enters the lungs or stomach.

Doctor Oswald* thinks the water does not enter the lungs, in drowning, during the efforts made to inspire, but after they have ceased; and indeed his experiments go far towards a confirmation of this opinion.

Coleman continues "The heart has frequently been observed to contract, or more properly to vibrate for more than two hours after respiration was suspended, and that from no other stimulus, but its own blood, while in other experiments the vibrations did not continue one tenth part of that time. The right side of the heart preserves its action much longer than the left, and the auricles much longer than their corresponding ventricles."

"The peristaltic motion of the intestines does not continue as long as the con-

* See Goodwyn's Essay on the connection of life with asperities

contractions of the heart, and on opening the head, the veins as in ordinary death are found rather distended, but without the least appearance of extravasations."

I shall now briefly enquire how the water acts in producing the effects just described. Does it act directly by entering the cavity of the lungs, or indirectly by excluding air from them? That a portion of water does enter the lungs of an animal when submerged, either during its efforts to inspire, or very soon after those efforts have ceased, is a fact well established; but that the quantity of water thus taken in, is insufficient to destroy life, I think, is very satisfactorily proved by a set of experiments instituted by Doctor Gosselin, for the purpose of ascertaining the fact. He first very ingeniously ascertained the quantity of fluid taken into the lungs in drowning, by confining animals submerged in Mercury, until they ceased to exhibit signs of life; it was then easy, after removing them, to determine the precise quantity of this fluid in the lungs, as the Quicksilver remained unmixt with the fluid contained in them in a healthy state; a circumstance which gives Mercury the preference to every other fluid in making these experiments. After having ascertained the quantity of fluid taken into the lungs in drowning, the Doctor, in order to discover whether that alone was sufficient to produce death, injected a quantity of water equal to the sum of the fluids (the Mercury and natural mucus of the lungs) found in the lungs of the drowned animals, through an opening made in the trachea of other animals which were in a healthy state. This produced no other symptom than a difficulty of breathing and a full pulse; both of which were soon abated and the animals lived several hours afterwards without much apparent inconvenience, when they were strangled.*

Thus it appears that, the water which enters the lungs of an animal after submersion is not sufficient to produce the changes which

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take place in drowning, and that these changes must be occasioned indirectly by the exclusion of air from the lungs.

I shall not enquire into the particular effects, either chemical or mechanical, which the air exerts on the lungs in respiration. The most type in Physiology is well acquainted with the fact that inspiration and of course life, cannot be supported without oxygen. Excluded an animal, by any means, from this vital pabulum, and death sooner or later will be the inevitable consequence. Whether oxygen gives irritability to the system, whether it is absorbed into the blood for other purposes; or whether it acts, by decarbonating the venous blood, which it meets with in the lungs without being absorbed at all, I shall not attempt to determine. For my purpose it is sufficient to know, that without it life cannot be continued. A knowledge of this fact leads to one of the most important indications for resuscitating the apparently dead from drowning, of the proper treatment of whom I am presently to speak. But in order that air may perform its proper office in the lungs, whatever that may be, it is necessary the influence of the nerves on those organs be duly excited.

That respiration in a healthy state is under the influence of the nerves distributed to the lungs; under that of the brain whence the nerves are derived, is I think, clearly demonstrated by some very interesting experiments of Mr. Dupuytren. This gentleman divided the eighth pair of nerves in a number of horses and dogs and found this division always mortal: compression of the nerves if continued any time, produced the same effect, it was even more speedily fatal. — The animals submitted to these experiments, exhibited all the appearances of asphyxia produced by a non respirable, but not deleterious gas; the blood in the arteries and veins becoming of a coal black.

Death appeared to take place in these cases, in consequence of the action of the lungs being suspended and not from the suspension

* See a paper read by M. Bispington, chief of the anatomical department
in the medical school of Paris &c. - translated for & published in the
Eclectic Repository, Vol. 1. Number III.

of the motion of the chest or of the heart; as whilst the asphyxia lasts, air continues to enter the lungs and the blood to circulate through them. "These compressions of the nerves was used and so regulated as to be alternately continued and suspended the animal could be made to pass from life to apparent death at pleasure." From these facts the propriety of paying such attention to the nerves, as that their influence may be duly determined to the lungs, in our attempts to recover the apparently dead from drowning, very evidently appears.

Numerous diagnostic marks have been laid down by writers, to distinguish the disease brought on by submersion from absolute death; but as there is a possibility of our being misled by these, and as such an error would be attended with the most fatal consequences, I cannot help thinking with Coleman, that, "It will can be better to have no criterion to judge of the absence of life, and make use of every means of recovery, in every instance than to rely on an imperfect and hazardous prognosis."

I proceed now to the indications of cure and the best means of fulfilling them. They are,

- 1st To restore to the blood its natural and healthy qualities and fit it for supporting life, by imparting to it the necessary influence of oxygen.
- 2nd To restore the circulation, in order that the blood may be conveyed to all parts of the body, to perform offices indispensable to the animal economy.

The first of these indications is to be fulfilled by inflating the lungs and stimulating the nerves; the second by stimulating the heart and blood vessels.

Before we proceed to the means of resuscitation it is necessary the patient should be put in a situation the most proper for the successful application of our different remedies. For this purpose he should be conveyed with as little agitation as possible, to the nearest habitation; the wet

* Various modes of applying heat have been recommended, such as the warm bath, covering the patient with heated sand, &c., but these in general take up too much time in their preparation, and retard or prevent the applications of other remedies.

clothes should then be immediately taken off and the body dried with warm soft flannel. If the weather be cold and the body or extremities frozen, the joints be rubbed with snow or cold water. He is then to be laid on a mattress or common bed covered with a warm blanket, and placed at such distance from the fire as to allow of a suitable degree of warmth being applied to the body, which should be occasionally turned. The head should be moderately elevated, taking care that there be also a sufficient elevation of the shoulders, to prevent any impediment to the circulation in the blood vessels of the neck.

The patient being prepared, we must inflate the lungs and put them in a condition for oxygen to effect the necessary change in the blood, which is to be made to pass through them, by stimulating the heart to action. This should be done at the same moment the lungs are inflated in order that the blood may be propelled through them to the left auricle; for the mere expansion of the lungs, and changing the blood in them by the intromission of oxygen will be of little benefit, unless the blood thus changed go to the left side of the heart to be distributed over the body. If pure oxygen gas can be speedily obtained, it should be preferred for inflating the lungs, if not, we must make use of atmospheric air. To prevent the deterioration of this, it will be proper to exclude from the room of our patient, all persons whose assistance is not absolutely necessary to his recovery.

Various instruments to inflate the lungs have been contrived. Mr. Hunter advises a pair of bellows constructed with two separate cavities, in such manner, that by expanding them when applied to the nostril or mouth of a patient, one cavity may be filled with common air and the other with air extracted from the lungs; and by shutting them against the common air may be thrown into the lungs and that drawn from the lungs, be discharged into the room. These may answer the purpose very well, as by these natural respiration may be pretty nearly imitated.

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Mr. Hiler's apparatus consists of an elastic tube, about twelve inches long, to one end of which is fixed an ivory or silver mouth piece, or by means of a hollow conical screw, a pair of bellows may be adapted to it; to the other end is added a piece of ivory of such form, as to enter and fill up a nostril. It is to be used thus; a proper person stationed at the head of the body to be operated on, passes the appropriated end of the tube into one of its nostrils and sustains it there with the four fingers, he compresses both nostrils so firmly between the thumb and middle fingers of the same hand, that no air can pass otherwise than by the tube; with the other hand he applies the other extremity of the tube to his mouth (if a bellows be not used) and blows with force through the pipe into the nostril of the patient. The medical assistant standing at the right side of the patient, keeps the mouth perfectly closed with his left hand, while with the right he makes a suitable pressure on the prominent part of the wind pipe, to prevent air from passing into the stomach, lifting the lungs are properly distended. He is to press strongly upon the chest, removing his left hand from the mouth, so as to let the air pass out; when by these means the lungs are compressed, the same process is immediately to be repeated, that as far as can be, natural respiration may be imitated.

Probably the most eligible way to inflate the lungs, would be to pass a pair of bellows on Mr. Coleman's plan, adapted to a curved tube made to pass into the trachea, such a one as is recommended by Coleman. It may however, frequently happen that none of the instruments contrived for distending the lungs, can be procured, without admitting of a dangerous delay. In such case we must resort to the use of a common bellows, the mouth of which is to be introduced into one of the nostrils and the same plan pursued as recommended for using Hiler's apparatus. If a bellows cannot be obtained, it might perhaps be advisable to make firm pressure on the thorax and abdomen, in order to expel as much of the air contained in

* Humboldt restored birds to life which were apparently dead,
by putting a small piece of zinc into the bill & a piece
of silver into the rectum & establishing the communication
by means of an iron wire.

See Wilkinson on Galvanism

the lungs as poppets, the poppets being removed, pure air will rush in to supply its place. By repeating this process the effect of artificial respiration might in some measure be produced.

If we are unable to inflate the lungs in any of the ways described, owing to a closure of the glottis from a spasm of its muscles, the operation of tracheotomy should be immediately performed, and the lungs inflated through the opening into the wind pipe. At the same time the lungs are inflated, moderate galvanic shocks should be passed alternately through the heart and basis of the brain; in order to promote the circulation of the blood and determine nervous influence to the lungs. It appears from experiments lately made in France, that the heart is dependent for its nervous influence on the spinal marrow; if so, passing the galvanic fluid through that might prove beneficial.

As galvanism is one of the most powerful agents we are acquainted with, in exciting the nervous system and producing contractions in the muscular fiber, it is reasonable to expect great advantage from its employment in those cases of apparent death, when excitability is not entirely exhausted. Fortunately in most cases of suspended animation from submersion a considerable degree of excitability remains. As a means of converting excitability into excitement in such cases, galvanism should never be omitted, when the apparatus necessary for its application can be obtained. Animals which were apparently dead have been restored by its influence alone.*

It has been supposed by some that the heart is not susceptible of the galvanic influence; but we have very respectable evidence to the contrary, as that of Astruc, Vesali, Sandi, and Humboldt.

To fulfil the second indication, namely, to restore the circulation of the blood; besides the use of galvanism, there are other auxiliaries which

* Doctor Samuel Jackson in his inaugural dissertation

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which should not be neglected. These are certain stimulating substances thrown into the body, frictions and particular stimuli applied to the nose and ears.

As the stomach is the centre of sympathy in the animal system, and as impressions made upon it are so speedily propagated to all the other parts, much service may be expected from the introduction of remedies into it. These should be of such nature as to act promptly and powerfully, as Ether, Volatile Alkali and ardent Spirits - Perhaps the latter of these articles will be found to answer the purpose as well as any other and it has the advantage of being generally at hand. These remedies may be very conveniently injected into the stomach by means of a syringe or bladder fixed to a tube, which is to be introduced into the oesophagus. If a convenience of this kind be not at hand, they may be cautiously poured down the throat, from a vessel with a spout, the patients head being a little elevated. The liquor should be warmed before being passed into the stomach. From six to eight ounces, in ordinary cases will be sufficient to inject at once; if the patient has been addicted to habits of intemperance the quantity must be increased. As Opium acts powerfully on the nervous system, it would probably increase the good effects of the spirits by being dissolved in it. The efficacy of these remedies will be increased if previously to their introduction, the water contained in the stomach, be extracted. This may be effected by means of a tube and syringe.

Stimulating Enemata should be thrown up the intestines. They should consist of some warm aromatic; they should not be large in quantity so as much to distend the bowels, which would be injurious by preventing the easy descent of the diaphragm - Hence the impropriety of using smoke in these cases. It has been suggested by a writer* on this subject that, oxygen or oxygenized water acid gas, injected into the intestines might do good, by impacting the influence of oxygen to the blood in their vessels; but I should suppose, whatever

probable

probable chemical good might result from the employment of these, would be more than counterbalanced by their mechanical harm. I need say nothing of the impropriety of the disproportion of the Tobacco injection, as its use is now I believe, condemned by every judicious practitioner. For an account of the deleterious effects of this article when used in cases of suspended animation, I refer the reader to the inaugural dissertation of Daniel Legare.

Frictions are of great importance and should not be neglected, they assist in propelling the blood through the languid vessels and at the same time stimulate the nerves of the skin. As a medium of friction a little sweet oil or any mild grease will answer the purpose perfectly well. When a mild substance of this kind is used, the frictions may be long continued without fear of excoriation; a circumstance which deserves attention, as this unpleasant and even dangerous effect cannot well be prevented when acrid substances are employed.

Planitatories applied to the nose, by inducing sneezing, may tend to restore excitement to the diaphragm and thus assist respiration. The sense of hearing has been said to remain longer in drowned persons than any of the other senses. This opinion seems to be corroborated, by what sometimes takes place in apparent death from other causes. Professor Rush, in his lectures, relates several cases where patients revive, after life has seemingly left the body, by the screams of afflicted relations. He relates one case in which life was recalled by the noise made by a number of voices, in singing a hymn, in the apartment of the supposed corpse, preparatory to removing it for interment. The effect of sound upon the ears of the apparently dead from drowning, certainly deserves a trial.

When by any means we have been fortunate enough to produce symptoms of life, and the motions of the animal machine begins

begin to return, we should relay our operations and proceed with the utmost circumspection. By overruling our part at this critical juncture, we might lose one of the highest pleasures attending the exercise of our profession, and have the severe mortification of seeing our patient perish, at the very moment we began to fancy our endeavours crowned with success. I cannot better express the line of practice we are to pursue, in the momentous stage of our patients recovery, just alluded to, than in the words of Dr Armstrong.

While the vital fire
Burns feeble, heap not the green fuel on;
But prudently foment the wandering spark
With what the soonest feels feels its removal touch:
Be frugal even of that; a little gives
At first; that kindles, add a little more;
Till by delicate nourishing the flame
Revised, with all its wanted vigor glows.

The period time at which our attempts to restore the unfortunate objects of our attention, should cease, cannot well be laid down; no general they should be continued at least four hours - Whilst there is yet reason to believe the faintest spark of life remains, we should not despair of being able to fan it into perfect animation. Nothing should induce us to omit our endeavours, whilst the remotest possibility, of preventing a fellow creature from being prematurely banished into eternity, remains. Do we fail? we have the consoling reflection of having done all, that duty and humanity required - Are we successful - our reward more than equals every exertion. Who would not rejoice at bringing back to life and repentance, the poor wretch,

who has prayed to put an end to the horrors of guilt, or despair, by
a watery grave — When the bosom that resists not throbs with plea-
sure next to divine, at being the instrument of restoring to helpless
and dependant family their comfort and support; by snatching from
the ever dominions of death, the kind husband and affectionate father —

To we respect the duty of man to man and of man to his God —
as we judge the feelings of a self approving conscience, we will perse-
vere in our attempts to resuscitate the apparently dead from dream-
ing —

